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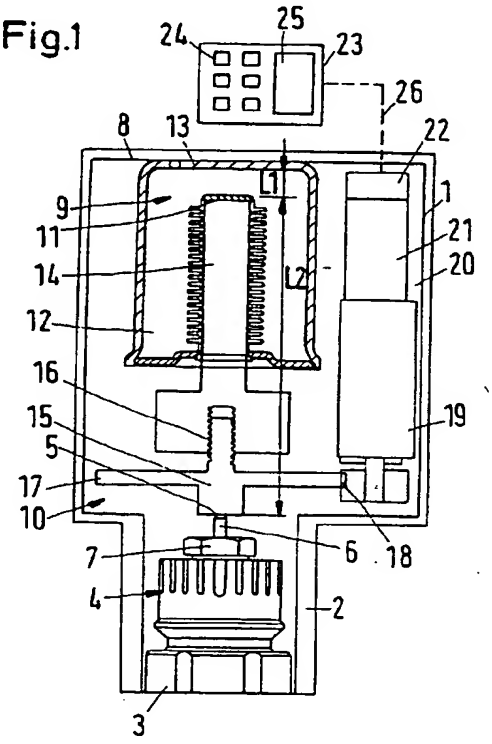
(54) Thermostat head for a valve

(57) A thermostat head for a valve (4) has a handle-free housing (1). In the housing is arranged a thermostatic element (9) adjustable in dependence of the temperature to be controlled. The associated desired value setting device is formed by a regulating unit (10) which is adjustable over the whole desired value range by means of an activator (19). The desired value input does not take place via a handle, but via a signal generator (23). This enables a very simple setting of the night set-back or a desired value programme, without causing excessive power consumption or an interruption of the control procedure at a power failure.

Fig.1



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Description

[0001] The invention concerns a thermostat head for a valve with a handle-free housing, with a regulating unit, which, on operation of an electrical activator, adjusts a contact surface controlling the valve and with a desired value input device operable by means of a signal generator.

[0002] A thermostat head of this kind is known from US-A 5 137 051. To enter a desired value or a desired value programme to cover a long period, a control panel with a keyboard and a display is arranged on the front side of a square housing. An electric circuit having a microprocessor compares the entered desired value with the measured room temperature and adjusts the motor provided with a feedback potentiometer by a distance corresponding to the control deviation, the contact surface facing the valve being adjusted accordingly. The entering of a desired value via a control panel is substantially less difficult and requires less force than the adjustment of a handle as existing on the commonly known radiator thermostat heads, a feature which is particularly welcomed by elderly users. As, however, the motor has to be started on each of the frequent control operations, a substantial power consumption occurs, so that the life of the batteries arranged in the housing is short, or a connection to the domestic power supply mains is required.

[0003] As a contrast to this are the widely known thermostat heads with a thermostatic element adjusting in dependence of the temperature to be controlled, serving itself as temperature sensor or being connected with a remote sensor via a capillary tube, and with a mechanical desired value setting arrangement, which is adjusted axially by turning a handle. Such thermostatic systems comprise a fluid-steam filling and a desired value spring counteracting the steam pressure, or a fluid or solid filling. These thermostat heads work completely autonomously, but each desired value change requires an adjustment of the handle.

[0004] Certainly, it is known from DE 43 09 121 A1 to have the option of adjusting the handle of a thermostat head manually or by means of motor inserted in the thermostat head. However, this is not a construction fit for the market, as the motor arranged in extension of the series connection of thermostatic element and desired value setting device leads to a very large height of the thermostat head.

[0005] Further, a thermostat head with handle is known from DE 31 35 895 A1, in which an extendible adapter is arranged between the desired value setting device and the contact surface, said adapter being a randomly heatable expansion body or a cam disc rotatable by a motor via a gear.

[0006] From DE 31 27 184 C2 is known an autonomous thermostat head with a rotatable thermostat housing for desired temperature value setting, the night setback of which is performed by means of an integrated steering and driving unit, which only requires energy during the adjusting operation. The rechargeable batteries used for this are supplied from solar cells arranged on the thermostat head. The embodiment of the steering and driving unit is not described.

[0007] The invention is based on the task of providing a thermostat head having a low power consumption and meeting its control requirements also on power failure (interrupted supply, empty batteries).

[0008] According to the invention, this task is solved in that in the housing is arranged a thermostatic element with associated desired value setting device the element being adjustable in dependence of the temperature to be controlled, and that this desired value setting device is made by the regulating unit, which is adjustable over the whole desired value area through the activator.

[0009] In this construction all advantages of a desired value setting without handle (convenient desired value entering, opportunity of programming, no mechanical power requirement) are maintained. However, the activator is not started for each control operation, but only adjusted in connection with a desired value change. The power consumption is accordingly low, and in the cases, where batteries are used, this leads to a longer life of the batteries. Between the adjusting operations the thermostatic element works automatically and without power consumption. In this connection it is particularly noticeable that due to the dispension of the handle the housing can have any desired cross section deviating from the circular shape, thus making no difficulties in view of the room saving arrangement of the activator, the transfer elements and any batteries, as even a small bulge on the housing will be sufficient to accommodate these parts. Thus, the new thermostat head need not be substantially larger than a thermostat head with handle.

[0010] Preferably, it is provided that the thermostatic element has a fluid or solid filling and that the regulating unit is arranged in series with the thermostatic element and changes its length on operation of the activator. The desired value is changed by a simple longitudinal adjustment of the regulating unit.

[0011] In particular, this can occur in that the axial length of the thermostatic element changes in dependence of the temperature to be controlled, that the axial length of the regulating unit changes on operation of the activator and that the regulating unit is arranged mechanically in series between a supporting surface of the housing and the contact surface.

[0012] An additional recommendable alternative provides that the thermostatic element has a fluid-steam filling and acts against a spring and that the regulating unit fits to one of the spring counter flanges and changes its length on operation of the activator. Thus, the position of the contact surface is on the one hand fixed by the balance between the spring force and the force of the steam pressure and on the other hand adjustable by

means of the regulating unit.

[0013] Preferably, the regulation unit lies next to the contact surface. Here one end of the thermostatic element and/or the spring can have a fixed bearing on the housing.

[0014] In most cases the thermostat head is used so that the valve opens more when the temperature to be controlled drops, as is the case with valves for radiators, underfloor heating, water heaters etc. However, the thermostat head is also suited for valves opening on temperature increases, for example refrigeration valves. This is done most simply in that in the housing a reversing device is allocated to the thermostatic element, which device reverses the operational direction of the thermostatic element with reference to the contact surface.

[0015] It is advantageous that the regulating unit comprises two mutually screwable parts, of which one is unrotatable and the other one is rotatable by means of the activator. The transforming of the rotational movement into the axial adjustment provides favourable transformation ratios, so that a small motor can be used.

[0016] With regard to the construction it is recommendable that the activator is arranged at the side of the thermostatic element and/or the regulating unit, and that for the purpose of accommodating the activator the housing has a shape which deviates from the circular cross section. This gives a compact housing construction, in which no axial height is required for the motor.

[0017] In this connection it is advantageous that the longitudinal axis of the activator is parallel to the axis of the thermostatic element and the regulating unit. This gives the dimensionally most compact solution.

[0018] In a preferred embodiment it is provided that the rotatable part of the regulating unit has a toothed wheel with circumferential toothing, with which a pinion driven by the activator meshes. As the activator practically acts direct upon the regulating unit, an inexpensive and compact construction occurs.

[0019] It is also preferred that the diameter of the toothed wheel is larger than that of the thermostatic element and that the diameter of the pinion is smaller than that of the toothed wheel. Thus, a large transformation ratio is obtained, which again enables the use of smaller motors.

[0020] Additionally, it is advantageous that at least one battery is also arranged in the housing. The thermostat head is thus autonomous, apart from battery changes required at long time intervals. The arrangement of a battery in the housing involves no difficulties, as the housing shape can be selected accordingly.

[0021] It is particularly provided that the battery is arranged at the side of the thermostatic element and/or the regulating unit near the activator. This gives a compact construction.

[0022] It is also recommendable that a filling monitor emitting an error signal when the filling falls below a limit value is allocated to the battery. The filling monitor can for example be a voltmeter. The error signal can trigger an optical or acoustic error notice.

[0023] It is particularly recommendable that on occurrence of an error signal from the activator the regulating unit is adjustable to a pre-set resting position. In connection with living-rooms this resting position may for example correspond to a desired value of 20°C, in connection with antifreeze the desired value may be 5°C. The desired values set in this way will also be maintained when the batteries are discharged.

[0024] Preferably, the activator is a motor, particularly a stepping motor. However, also other activators can be imagined, for example magnetic systems with notches.

[0025] It is also advantageous that a control circuit is provided, which, on entering a new desired value, compares this with the desired value setting and drives the activator by a measure corresponding to the difference. A control circuit of this kind can also be arranged inside the housing.

[0026] In a further embodiment of the invention it is possible that the signal generator has a keyboard and/or a display. It can also be arranged on the housing and/or be part of a remote control.

[0027] In the following the invention is described on the basis of preferred embodiments in connection with the drawings, showing:

Fig. 1 a schematic view of a first embodiment of a thermostat head for a heating valve in accordance with the invention

Fig. 2 a modified embodiment for a refrigeration valve

[0028] The thermostat head in Fig. 1 has a housing 1, which is fixed on the top part 3 of a radiator valve 4 by means of a socket 2. The housing 1 is shown to be a single part, in practice, however, it comprises several parts connected with each other. The valve 4 is activated in that an axially adjustable contact surface 5 acts upon a valve tappet 6, which is lead to the outside through a stuffing box 7.

[0029] Between a supporting surface 8 of the housing 1 and the contact surface 5 a thermostatic element 9 and a regulating unit 10 are arranged, which are connected with each other via a coupling surface 11. The thermostatic element 9 has a solid filling 12 and is at the same time actual value sensor. The front wall 13 of the thermostatic element 9 bears direct on the supporting surface 8 of the housing. The axial length L1 of the thermostatic element 9 changes in dependence of the actual value of the room temperature. The axial length L2 of the regulating unit 10 changes in dependence of the setting of the desired value.

[0030] The regulating unit 10 comprises an unrotatable part 14 and a rotatable part 15, which are connected with each other via a screw thread 16. The rotatable part 15 carries a gear wheel 17, which is drivable by means

of an electric motor 19, for example a stepping motor, via a pinion 18. The motor 19 is arranged in a bulge 20 on the housing 1, which also accommodates batteries 21 for driving the motor 19 and a control circuit 22. For this purpose the axes of the motor 19 and the batteries 10 are parallel to the axes of the thermostatic element 9 and the regulating unit 10. The gear wheel 17 has a very large diameter, which exceeds the diameter of the thermostatic element 9. Compared with the gear wheel diameter the pinion 18 has a small diameter.

[0031] A control circuit 22 arranged inside the housing 1 has a desired value input device, which co-operates with a signal generator 23 and has, for example, a keyboard 24 and a display 25. The signal generator 23 is designed as a remote control, so that the signal generation to the control circuit 22 occurs wirelessly or via a cable connection 26. By means of this signal generator 23 the desired value or a desired value programme meant for a longer period (day, week, year) is supplied to a memory in the control circuit 22. Then each change of the desired value will cause the control circuit 22, which also comprises a timer, to drive the motor 19 by a measure corresponding to the change. The change of the length L2 caused by this specifies the new desired value for the thermostat head.

[0032] Further, the control circuit 22 comprises a filling monitor, which monitors the charging state of the batteries 21, for example by means of a voltage measuring. When the filling comes below a limit value, an error signal is generated, which on the one hand triggers an optical signal in the display 25, and if required also an acoustic signal elsewhere, and also provides that the regulating unit 10 is turned to a predetermined resting position, for example to a desired value position of a 20°C room temperature.

[0033] In Fig. 2, in which a thermostat head for a refrigeration valve is shown schematically, reference signs increased by 100 in relation to Fig. 1 are used for corresponding parts. Initially, a difference is that the thermostatic element 109 contains a fluid-steam filling an is connected with a remote sensor 128 via a capillary tube 127. Thus, via an intermediate link 129 the thermostatic element 109 acts upon a reversing device 130 in the form of an angled lever, whose second arm is loaded by the counter flange 131 of a spring 132. For this reason the unrotatable part 114 of the regulating unit 110 assumes a position depending on the steam pressure in the thermostatic element 109 and the power of a spring 132 counteracting this steam pressure. This leads to a reversal of the operational direction of the thermostatic element 109 with regard to the contact surface 105. A motor-driven adjustment of the gear wheel 117 will change the length of the regulating unit 110 and thus also the desired value. In this embodiment the signal generator 123 is arranged at the front side of the housing 101.

[0034] The embodiment of Fig. 2 can also be operated with a fluid filling. Then the spring 132 is to be constructed as a security spring, that is, with a relatively large rigidity. A security spring of this kind is also provided in the embodiment according to Fig. 1, however, for reasons of a simpler view, it is not shown.

[0035] When the thermostat heads according to the invention are used for heating valves (room heating or underfloor heating), the desired value can be entered manually via an operating panel. A time dependent night setback can be provided, which again can be overridden if wanted, for example, when guests are expected. A complete desired value programme for a whole week can be set. In connection with the heating of a hot water tank a night setback of the water temperature can give large savings. Also in connection with refrigeration valves it is often favourable to adapt the desired value to the requirements. In connection with an underfloor heating it may be suitable to arrange a remote sensor on a hot water tube to provide a control of the room temperature on the basis of the flow temperature of the water. It is also important that the thermostat heads can be adjusted via a remote control, preferably a whole group of such thermostat heads can even be adjusted from a common central unit. The remote-controlled thermostat heads no longer have to be accessible for the desired value setting. Thus they can be arranged anywhere in a building, even in the basement.

[0036] Advantageously, the batteries are arranged in the housing. However, they can also be placed in a remote control unit or, in connection with radiators, in a housing behind the radiator. Expediently, the batteries are rechargeable, particularly via a remote control unit.

[0037] The regulating unit must not necessarily consist of two mutually screwable parts, but can also be made as a profiled disc, the activator pushing sections with differing thicknesses between the contact surface and the thermostatic element. In stead of the toothed gearing shown, a different transmission can be used, for example, a belt drive etc. Further, the gear wheel 17 can be replaced by a worm wheel and the pinion 18 by a worm, the axis of the motor 19, 119 then expediently extending transversal to the axes of the thermostatic element 9 and the regulating unit 10.

Claims

1. Thermostat head for a valve with a handle-free housing, with a regulating unit, which, on operation of an electrical activator, adjusts a contact surface controlling the valve and with a desired value input device operable by means of a signal generator, **characterised in** that in the housing (1; 101) is arranged a thermostatic element (9; 109) with associated desired value setting device the element being adjustable in dependence of the temperature to be controlled, and that this desired value setting device is made by the regulating unit (10; 110), which is adjustable over the whole desired value area

through the activator (19; 119).

2. Thermostat head according to claim 1, **characterised in** that the thermostatic element (9) has a fluid or solid filling and that the regulating unit (10) is arranged in series with the thermostatic element and changes its length on operation of the activator (19).

3. Thermostat head according to claim 1 or 2, **characterised in** that the axial length (L1) of the thermostatic element (9) changes in dependence of the temperature to be controlled, that the axial length of the regulating unit (10) changes on operation of the activator (19) and that the regulating unit (10) is arranged mechanically in series between a supporting surface (8) of the housing (1) and the contact surface (5).

4. Thermostat head according to claim 1, **characterised in** that the thermostatic element (109) has a fluid-steam filling and acts against a spring (132) and that the regulating unit fits to one of the spring counter flanges (131) and changes its length on operation of the activator (119).

5. Thermostat head according to one of the claims 1 to 4, **characterised in** that the regulation unit (10; 110) lies next to the contact surface (5; 105).

6. Thermostat head according to one of the claims 1 to 5, **characterised in** that in the housing a reversing device (130) is allocated to the thermostatic element (109), which device reverses the operational direction of the thermostatic element with reference to the contact surface (105).

7. Thermostat head according to one of the claims 1 to 6, **characterised in** that the regulating unit (10; 110) comprises two mutually screwable parts, of which one (14; 114) is unrotatable and the other one (15; 115) is rotatable by means of the activator (19; 119).

8. Thermostat head according to one of the claims 1 to 7, **characterised in** that the activator (19;119) is arranged at the side of the thermostatic element (9; 109) and/or the regulating unit (10; 110), and that for the purpose of accommodating the activator (19; 119) the housing (1; 101) has a shape which deviates from the circular cross section.

9. Thermostat head according to claim 8, **characterised in** that the longitudinal axis of the activator (19) is parallel to the axis of the thermostatic element (9) and the regulating unit (10).

10. Thermostat head according to one of the claims 1 to 9, **characterised in** that the rotatable part (15; 115) of the regulating unit (10; 110) has a toothed wheel (17; 117) with circumferential toothing, with which a pinion (18; 118) driven by the activator (19; 119) meshes.

11. Thermostat head according to claim 10, **characterised in** that the diameter of the toothed wheel (17; 117) is larger than that of the thermostatic element (9; 109) and that the diameter of the pinion (18; 118) is smaller than that of the toothed wheel (17; 117).

12. Thermostat head according to one of the claims 1 to 11, **characterised in** that at least one battery (21; 121) is also arranged in the housing (1; 101).

13. Thermostat head according to claims 8 and 12, **characterised in** that the battery (21; 121) is arranged at the side of the thermostatic element (9; 109) and/or the regulating unit (10; 110) near the activator (19; 119).

14. Thermostat head according to claim 12 or 13, **characterised in** that a filling monitor emitting an error signal when the filling falls below a limit value is allocated to the battery (21; 121).

15. Thermostat head according to claim 14, **characterised in** that on occurrence of an error signal from the activator (19; 119) the regulating unit (10; 110) is adjustable to a pre-set resting position.

16. Thermostat head according to one of the claims 1 to 15, **characterised in** that the activator (19; 119) is an electric motor.

17. Thermostat head according to claim 16, **characterised in** that the motor is a stepping motor.

18. Thermostat head according to one of the claims 1 to 17, **characterised in** that a control circuit (22; 122) is provided, which, on entering a new desired value, compares this with the desired value setting and drives the activator (19; 119) by a measure corresponding to the difference.

19. Thermostat head according to one of the claims 1 to 18, **characterised in** that the signal generator (23) has a keyboard (24).

20. Thermostat head according to one of the claims 1 to 19, **characterised in** that the signal generator (23) has a display (25).

21. Thermostat head according to one of the claims 1 to 20, **characterised in** that the signal generator (123) is arranged on the housing (101).

22. Thermostat head according to one of the claims 1

to 20, **characterised in** that the signal generator (23) is part of a remote control.

Fig.1

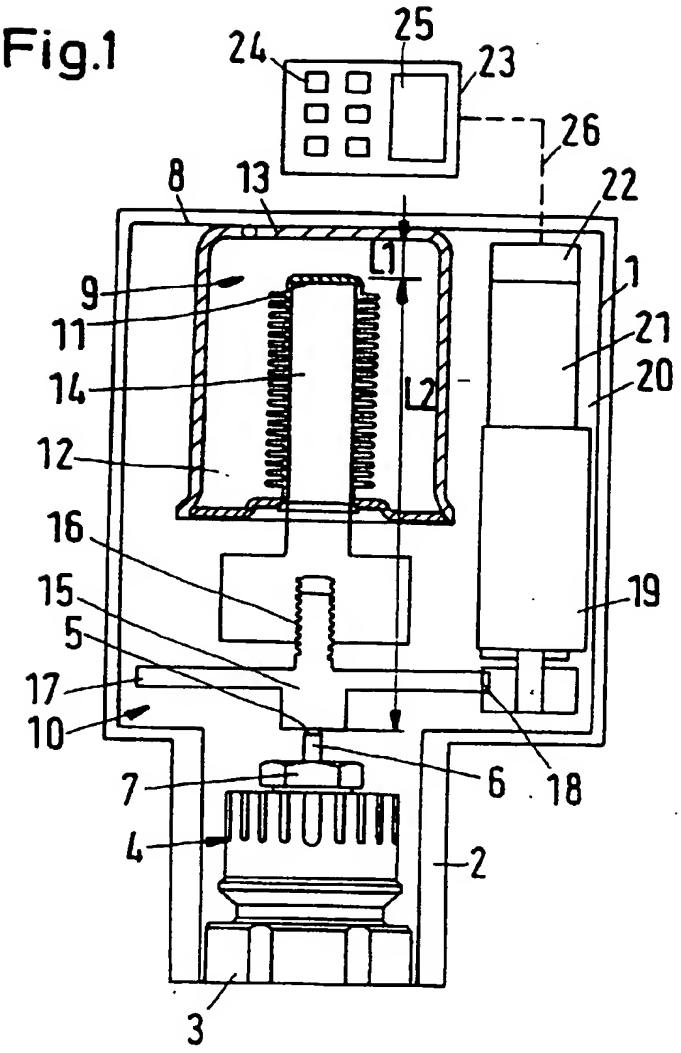
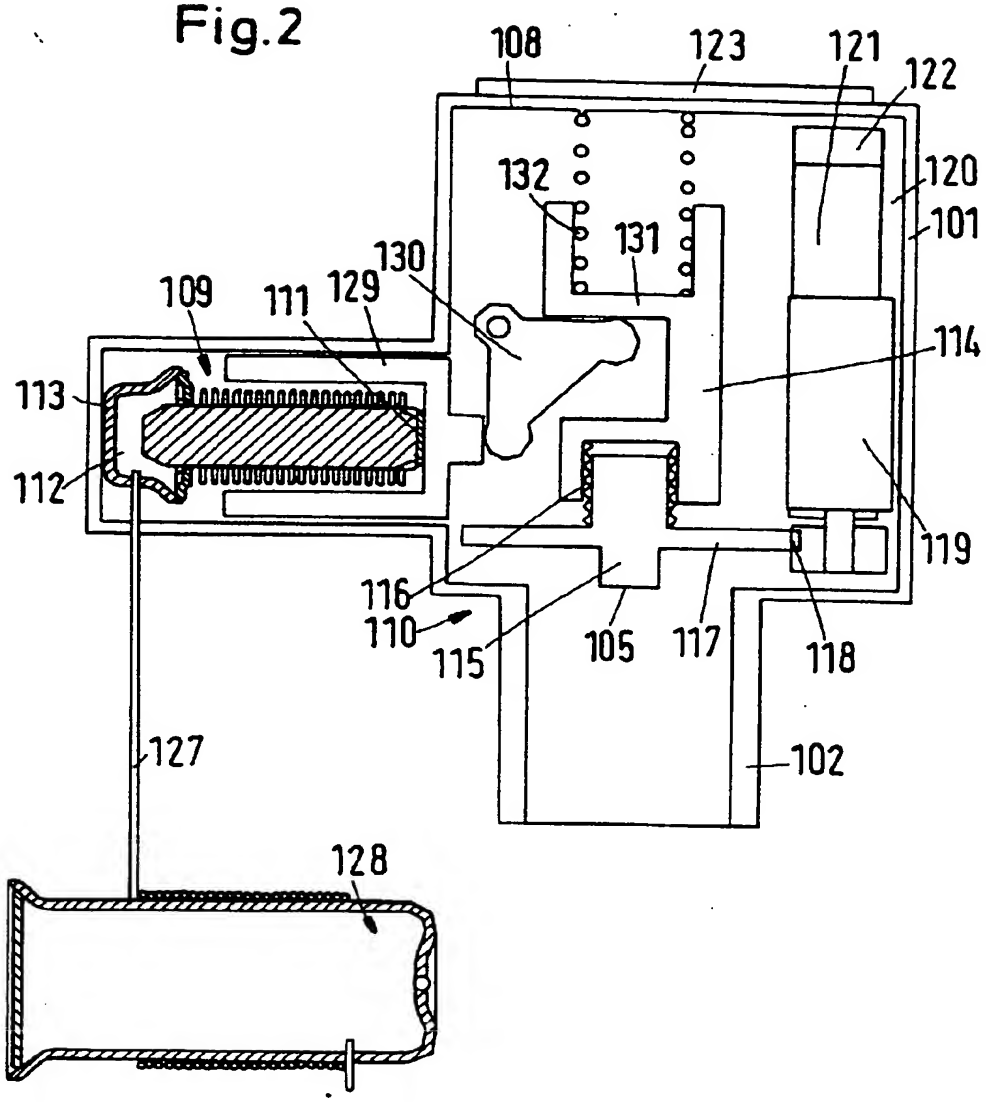


Fig.2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EUROPEAN SEARCH REPORT

Application Number
EP 98 20 3927

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A,D	DE 43 09 121 A (ROBERT BOSCH GMBH) 29 September 1994 * the whole document *	1	G05D23/02
A	DE 31 48 268 A (BADISCHE UHREFABRIK GMBH) 16 June 1983 * page 8, paragraph 2; figures 1-7 *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 18, no. 426 (P-1784), 9 August 1994 & JP 06 131057 A (FUJI SEIKO KK), 13 May 1994 * abstract *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 16, no. 578 (M-1346), 17 December 1992 & JP 04 228988 A (MATSUSHITA ELECTRIC IND CO), 18 August 1992 * abstract *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) G05D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 March 1999	Goetz, P

CATEGORY OF CITED DOCUMENTS

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10-03-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4309121 A	29-09-1994	NONE	
DE 3148268 A	16-06-1983	NONE	

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